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# IMPROVEMENT OF SYSTEMS FOR CLEANING CONVEYOR BELTS

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Systems for cleaning conveyor belts are examined and the factors influencing the cleaning efficiency and operational reliability of the cleaning setups are determined. Improvements to scraper and screw cleaners which remove abrasive and strongly adhering raw materials are proposed.

***Key words:*** cleaning system, conveyer belt, scraper, conveyor belt seam, rotary brush, twin-screw cleaning setup, raw material.

The production of containers and other articles made of glass involves a large volume of transport and process operations associated with the movement of raw materials, some of which (wet cullet, natural chalk, nitrates, batch and others) are characterized by strong adhesion and are prone to actively adhere to the conveyor belt during transport. In addition, if the adhered load on the empty branch of the conveyor belt is not removed, the raw material losses increase considerably, the overall service life of the transport unit decreases and the operational reliability of the entire production line drops. The adhered material not only results in accelerated wear of the belt due to the formation of a crust, which is difficult to remove, on the rollers but it also increases the dynamic loads on the supporting rollers and the conveyor drums and it increases the dust and dirt in the production rooms. For this reason, reliable cleaning setups are required in order to prevent obstructions and spills in the space beneath the conveyor, which promotes normal working conditions and increases the service life of the belt and other rotating units of the conveyor.

There exist different systems for cleaning conveyor belts. Scraper and brush setups, placed in the material off-loading zone after the drum driving the belt conveyor, are most widely used in the glass industry. The scraper setups are equipped with working elements made of metal, durable rubber, polyurethane or ceramic and are built with a hinged frame, which is pressed against the belt by means of a load or spring with the aid of a level. Sometimes, to make the cleaning more effective the rectilinear or parabolic scrapers are twinned and placed with different gaps from the surface of the belt, which makes it possible to remove the main layer of the adhered material first by means of the first blade and then to perform finer cleaning with the second cleaning element.

Segmented scraping setups where individual scrapers (blades) lie across the belt in a single line or in a checkerboard arrangement and are pressed against the belt by an elastic rod for each blade and a common spring or by levered suspension of the carrier frame are widely used.

However, all scraper cleaners for conveyor belts operate effectively only if the belt is jointed, which is accomplished either by gluing (which requires about 24 h) or cold vulcanization with each layer of the belt separated beforehand at the joint. But, in practice, because time is short, such gluing is replaced by more efficient jointing by means of metal cramps, rivets or other contrivances. This situation pertains especially to continuous production, for example, in the fabrication of glass containers, when an assembly conveyor transporting cullet and quenched cullet shuts down in an emergency situation and it is almost impossible to joint the belt by gluing in the short time available. In this case, ordinarily, the maintenance workers stop the belt manually and as a result the scrapers breakdown quickly because the cleaner is subjected to whipping due to the lapped joint and must be discarded.

A well-known technical solution [1] partially solves this problem by introducing into the construction of the scraping setup additional S-shaped hooks which are in contact with the surface of the belt and pivotally connected with the frame in order to secure the scrapers. As the lapped belt joint passes by, impact loads arise on the scraper of this mechanism and act on the S-shaped hooks, which turn along the generatrix and move the scarper away from the surface being cleaned. A drawback of this setup is that it cannot function effectively with segmented or curvilinear scrapers because only the ini-

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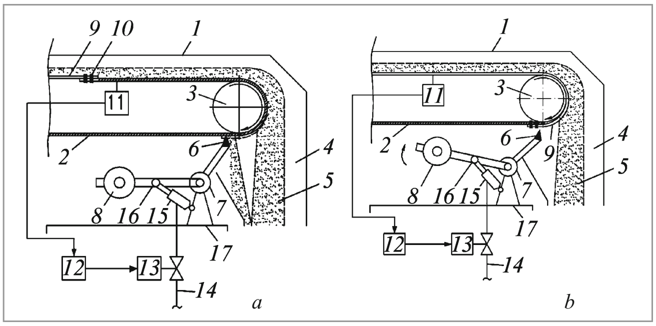


**Fig. 1.** Setup for cleaning a conveyor belt: *a*) scraper pressed against the belt; *b* ) scraper moved away from the belt.

tial section of the scraper is protected from the impacts imparted by the joint and the scraper quickly fails and gradually destroys the belt joint.

We have proposed a different conveyor belt scraper system [2] that eliminates the undesirable effect of the lapped belt joint on the serviceability of the scraper system. The apparatus works as follows. After the conveyor drive *1* (Fig. 1*a* ) is switched on the ribbon *2* carrying a load starts to turn and rounds the driving drum *3* in the zone *4* where the material *5* is off-loaded. The edge of the scraper *6*, placed on the turning frame *7* of the cleaning setup, is pressed tightly against the belt by the counterweight *8* and removes the particles of raw material adhered to the belt. As the belt lap joint *9*, made with metal rivets *10* or clamps, approaches the induction sensor *11*, which responds to metal, a short pulse is generated in the sensor and enters the control block *12*, comprised of two timing relays. The first relay forms a delay, determined by the passage time of the belt joint from the sensor *11* to the scraper edge *6*, and the second one sets the connection duration of the electromagnetic diffuser *13* on the compressed air line *14*. The duration of this connection depends on the passage time of the lapped belt joint in the scraper contact zone and can vary from 0.2 to 0.5 sec. During this period of time compressed air is delivered to the pneumatic cylinder *15*, whose rod is pulled out and turns the frame *7*, secured on the base (platform) *17*, through a pivoted connection *16* by a small angle (several degrees).

A gap forms between the belt and the scraper (Fig. 1*b* ). For a short time this gap prevents the scraper edge from coming into direct contact with the belt joint. And, only the belt joint moves beyond the action zone of the cleaning mechanism; the electromagnetic air diffuser *13* is switched off and the articulation system presses the scraper against the belt owing to the counterweight and returns the system into the initial state.

This cleaner makes it possible to periodically move the scraper away from the surface being cleaned for the passage time of the lap joint above the scraper edge, which increases the operational reliability of the cleaner and preserves the integrity of the conveyor belt.

In addition to the scraper mechanisms, brush setups are also often used to remove materials adhered to conveyor belts. The rotary brushes in such setups, also used to clean chevron and complexly shaped conveyor belts, are put into motion by an individual drive or a driving drum of the conveyor through a step-up gear, and the cleaning elements are fitted with rubber strips made of elastic synthetic materials or are assembled from bundles of kapron filaments. Since the contact of bundles of such filaments with the load-bearing surface during cleaning is weaker, brush systems are not so demanding of the belt jointing method, but like scrapers they also have a number of drawbacks. In spite of the recommendations presented in the technical literature [3, 4], rotating brushes work better with dry and nonabrasive rather than moist and hygroscopic components of glass batch.

The removal of abrasive loads (wet cullet) from the belt very quickly leads to complete wear of the cleaning elements, and the strongly adhering particles of the raw material being removed accrete on the brushes. To minimize this action on the cleaning capacity of the brush setup it is necessary either to install an additional contrivance to clean the brushes themselves or to increase the spacing of the cleaning elements and arrange the bundles of kapron fibers in separate rows or along a spiral line, imparting to the cylindrical surface of the setup the form of a rotor or screw mechanism.

In this connection screw mechanisms and roller designs are of interest. One such design contains a rotating roller mounted after the driving drum and positioned in contact with the non-working surface of the running-down branch of the belt [5]. The surface of the roller is riffled by means of low ribbing comprised of plates, angle bars and rods, while the roller itself is pressed tightly to the conveyor belt.

Belt cleaning performed with such a roller becomes less effective with time because material sticks between the ribs, as a result of which the riffled surface gradually becomes smooth and stops removing the adhered particles of the raw material. A similar effect is also observed for a single-screw cleaning setup, which requires regular cleaning of the shaft and screw surface in order to remove the wet and strongly adhered material which is prone to stick.

This drawback can be eliminated by means of a twin-screw cleaning setup patented by the authors of [6]. In the belt feeder *1* (Fig. 2), equipped with such a setup, after the electric drive *3* is actuated the semidry material starts to flow from the hopper *2* to the load-bearing surface of the belt *4* and is transported to the off-loading hopper *5*. The bulk of the material *6* pours immediately into the hopper and then flows to another process unit (not shown), while the adhered particles *7* move to the twinned screw *8*, comprised of two divergent screw *9* and *10*, coupled with one another by a toothed gear *11*. Rotation is transferred to the screw *9* from the shaft of the driving drum *12* by means of kinematic coupling *13* (chain or V-belt transmission), while a toothed gear imparts rotational motion in the opposite direction to the screw *10*. Since the twin-screw *8* is placed on the support *14* beneath the spring in order to increase the operating effi-

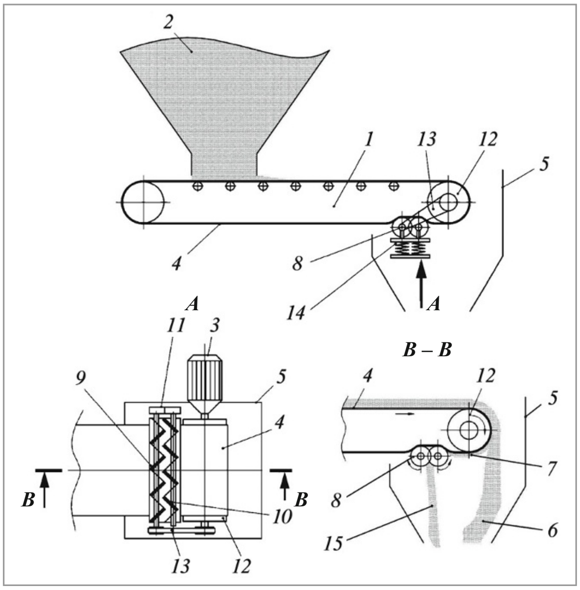


**Fig. 2.** Belt feeder with a twin-screw cleaning setup.

ciency, the screws *9* and *10* are pressed tightly against the belt *4* and stabilize the cleaning process.

The mutual coupling of the divergent screw turning in opposite directions enables mutual cleaning of both blades and increases the cleaning quality because the contact zone of the belt and twin-screw conveyor is larger. The material *15* removed in this zone by means of the screws *9* and *10* is drawn into the interscrew space and dumped into the main flow of the transported material.

However, it should be noted that the belt feeders or conveyors equipped with such cleaning setups, which actually are scraping mechanisms (the rotating blades of the screws play the role of scrapers), must have a belt jointed by gluing. This is due to the fact that it is much more difficult to move the twin-screw cleaner for a short period of time away from the lapped belt joint passing above the cleaning setup than in a frame setup with an ordinary scraper. In addition, the cleaning setups and systems with a twin-screw arrangement are best used for short feeders intended only for transporting strongly adhered and highly hygroscopic raw materials.

In summary, the design improvements made in the scraper and twin-screw systems for cleaning conveyor belts expand their functional possibilities and improves the operation of continuous transport lines carrying bulk components of glass and other types of batches (specifically, for ceramic production) with different physical-chemical properties.

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